Example 3.6 For the slider-crank mechanism shown below, where \( r_1 = 2 \text{ cm}, \ r_2 = 3.5 \text{ cm}, \ r_3 = 9 \text{ cm}, \) and \( \Theta_2 = 30^\circ, \) determine the velocity polygon when \( \dot{\Theta}_2 = 50 \text{ rad/s}. \) Specify \( \bar{V}_0, \dot{\Theta}_3, \) and \( \bar{V}_C. \)

\[
\begin{align*}
V_B &= r_2 \dot{\Theta}_2 = 3.5(50) = 175 \text{ cm/s} = 0.175 \text{ m/s} \\
V_{0/B} &= 8.4 \text{ cm} \Rightarrow 84 \text{ cm/s} \\
\dot{\Theta}_3 &= \frac{V_{0/B}}{r_3} = \frac{16.8}{9} = 1.86 \text{ rad/s} \\
V_D &= 7.8 \text{ cm} \Rightarrow 78 \text{ cm/s} = 0.78 \text{ m/s} \\
V_C &= 4.9 \text{ cm} \Rightarrow 49 \text{ cm/s} = 0.49 \text{ m/s}
\end{align*}
\]

Find \( V_B, \) perpendicular to \( r_2. \) Trace \( V_{0/B} \) (perpendicular to \( r_3 \)) and \( V_D \) (horizontal), where they intersect that is the velocity of point D \( (V_D). \) The velocity of C can be determined from either B or D, trace two lines one from point B on the polygon with the direction perpendicular to \( r_3 \) and the other one from D with the direction perpendicular to \( r_3, \) the intersection results in \( V_C. \) Notice the triangle BCD is image of the coupler link.
Consider the inverted slider-crank mechanism shown below.

Assume the mechanism at $\Theta_2 = 330^\circ$ and moving with a constant rotational speed of $\dot{\Theta}_2 = 30 \text{ rad/s}$. Determine the velocity and acceleration polygons. Find the angular velocity and acceleration of link 3 and the linear velocity and acceleration of the slider.

B2 and B3 are coincident points, B2 is the pin joint and B3 is a point on the rod (link 3). These points have different velocities, $V_{B2}$ must be tangent to $r_2$, while $V_{B3}$ must be tangent to $r_3$.

Find velocity of B2. Then find velocity of B3.

The resulting relative velocity $V_{B2/B3}$ says how B3 is moving relative to the slider (to the left). Therefore, the slider is moving to the right relative to B3 or O3.

$$V_{B2/B2} = r_{B2/B2} \dot{\Theta}_2 = 5 \times (30) = 150 \text{ cm/s}$$

Scale 1 cm = 25 cm/s

$$V_{B2} = V_{B2/B2} = 36 \text{ cm/s}$$

$$V_{B3} = V_{B2} + V_{B3/B2}$$

Trace lines

Known direction solved from link 3

4.8 cm

120 cm/s

O

$\Theta_3 = \frac{V_{B3/B2}}{r_{B3/B2}} = \frac{120}{4.36} = 27.5 \text{ rad/s}$